BROOKHAVEN BULLETIN

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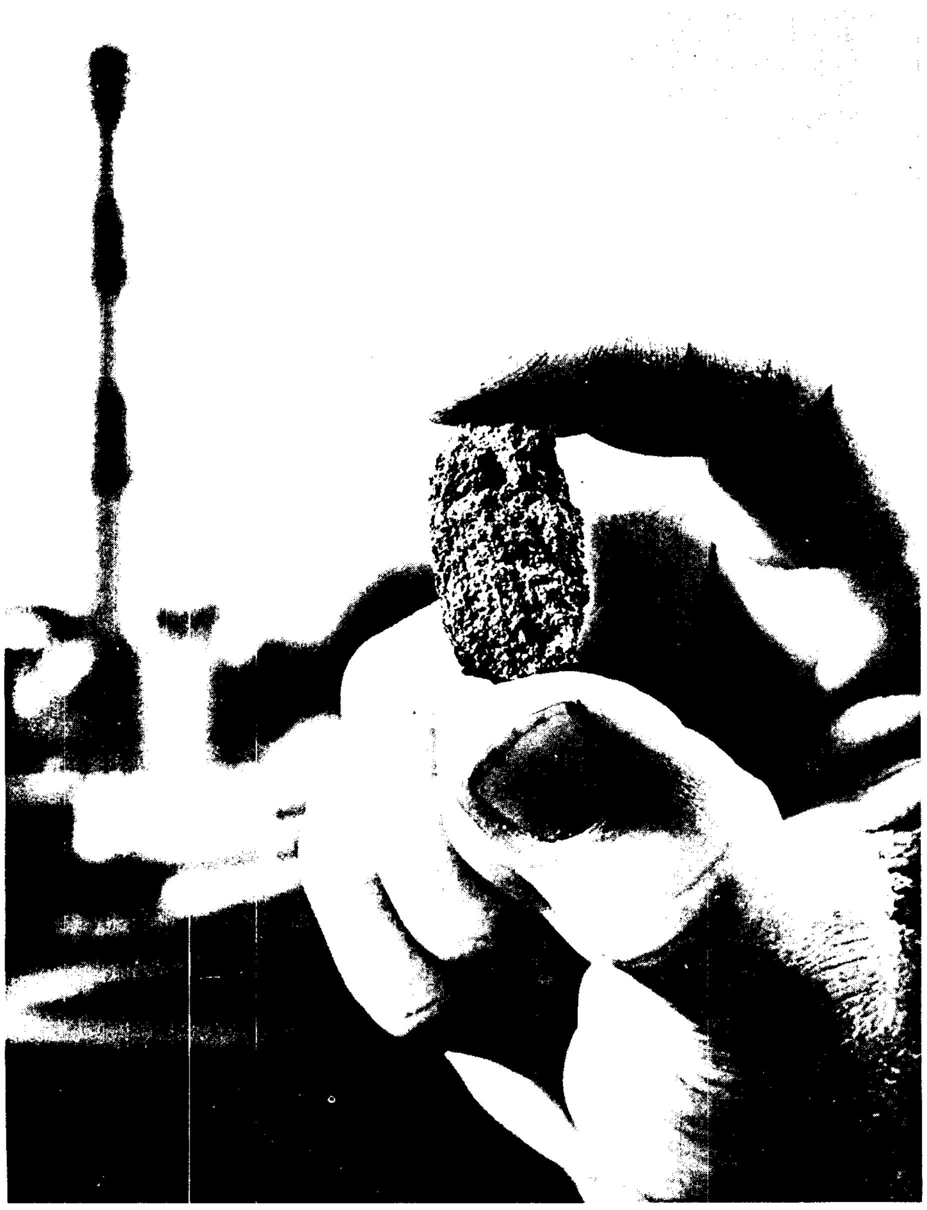
Moon Rock Displayed At Brookhaven



This precious moon material was a 12-gram piece of rock #10057, part of a larger rock that weighed 919 grams. After display to the public on Visitors' Day, the sample will be worked on in the Chemistry Department laboratories and then remnants of the rock will be returned to the Lunar Receiving Laboratory in Houston, Texas for future examination.

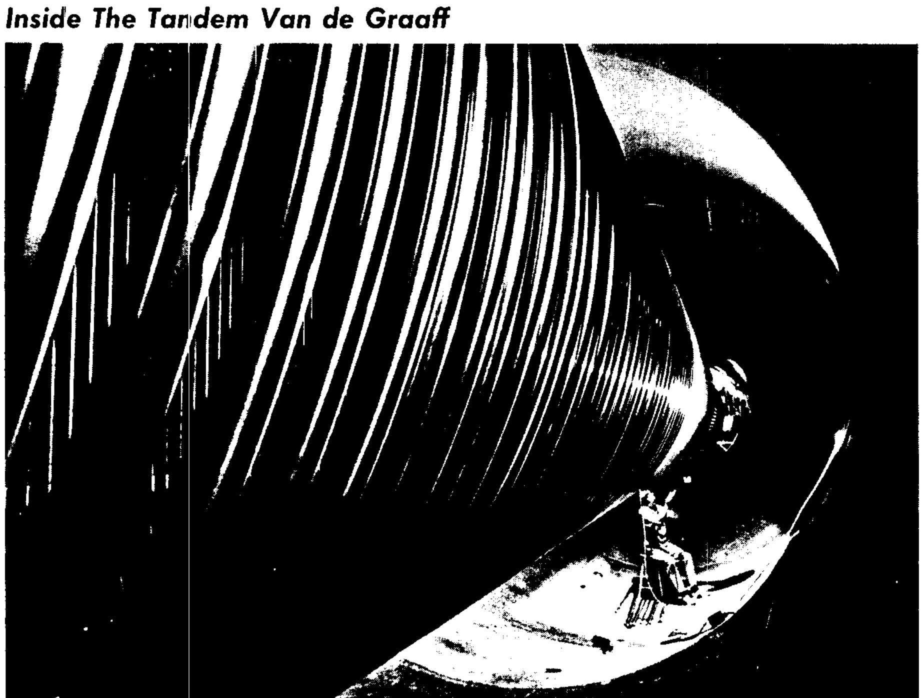
Moon Sample At Brookhaven

The 12-gram rock on exhibit at Brookhaven National Laboratory is a vesicular fine-grained basalt type rock. It is designated as specimen number 10057, 28 by NASA, and is part of a larger rock that weighed 919 grams when it was brought back to earth by the Apollo 11 astronauts.

According to Dr. Raymond Davis, Senior Scientist, and a principal investigator for the NASA lunar research effort, the minerals in the rock are feldspar, pyroxene and ilmenite. The specimen is abundant in spherical vesicules (cavities) from one-half to one and one-half millimeters in diameter. The rock contains two sets of fine fractures and is considered a moderately shocked rock, indicating that it was thrown out of the lunar surface by a meteorite impact. The surface shows a number of fine craters formed by micrometeorite impacts when the rock was resting on the lunar surface.

The research at BNL will involve heating the sample to drive off the gases it contains, and then analyzing the gases for their radioactivity. The principal gases to be analyzed are argon, krypton, and xenon. By comparing their analysis of the radioactive (non-stable) gas, which has a known half-life, with the stable isotopes of the same gas, much new information can be learned about the moon history, and hence add to man's knowledge about outer space and our universe.

Inside The Tandem Van de Graaff



The Tandem Van de Graaff will be open for visitors for the first and only time during the 1969 Visitors' Days. This giant new accelerator has been under construction for the past several years and will soon be in operation. This picture shows work being done inside the containment tank of the accelerator. After the machine is in operation there will be little opportunity during the research program for shut down for exhibition to visitors.

A Welcome From B N L's Director

On this, our 20th Annual Visitors Day, I am delighted to welcome you to Brookhaven National Laboratory.

Twenty years ago the Laboratory was just beginning to take form. We were a small staff of 1350. The finishing touches were being given to our graphite reactor before beginning operation. The Alternating Gradient Synchrotron had not yet been proposed nor had the High Flux Beam Reactor been thought of.

Much has happened in two decades. The staff has more than doubled. The Brookhaven Graphite Research Reactor has been put on a stand-by basis after a highly successful career. The AGS is the western world's highest energy accelerator and the HFBR is a working productive reactor.

We have a research hospital whose staff is making great strides in medical research and the Tandem Van De Graaff is almost completed. We have sent biology experiments into orbit with the Biosatellite II project and we have a neutrino observatory out in South Dakota which is searching for neutrinos from the sun.

During the first week of October, 1969, on an unheralded flight from Houston, a small piece of moon rock from that first fantastic voyage was delivered to Brookhaven for analysis by our chemists. We do not yet know where the lunar scientific findings here and at other laboratories will lead us.

We plan to push on, to try to lift the veil from further unknowns in the fields of physics, chemistry, the life sciences, engineering, mathematics and instrumentation.

Many exciting discoveries have been made through the perfecting of our research techniques and through the skill of our scientists and university collaborators.

Two recent significant developments in research may soon have wide application: the use of L-Dopa as a treatment for Parkinson's disease has been developed here by Dr. Cotzias and his group at the Medical Center; an improved type of concrete called "concrete polymer" made by using radiation to combine conventional concrete and plastic is being developed by the Radiation Division of the Department of Applied Science.

Dr. Maurice Goldhaber, Director of Brookhaven.

We have invited you here today to see for yourselves what we are accomplishing and to keep you informed of the latest developments in scientific research so vital to our life and times.

It is my sincere hope that you will find your visit both rewarding and inspiring.

Brookhaven Laboratory Founded In 1947 As National Center For Atomic Research

It's a long way from "Yip, Yip, Yaphank" to a walk on the moon, but the site of Brookhaven National Laboratory has been a part of it all. During World War I, these 7500 acres became Camp Upton and it was here that Irving Berlin first staged his musical and introduced the universial lament "Oh How I Hate To Get Up In The Morning." After the war the camp lay idle until occupied by a contingent of CCC men who came and went during the Depression and planted the beautiful white pines now evident here. From the late 30's to the outbreak of World War II, Camp Upton was again empty. Then once again the military took over and the site served as a basic training camp, a prisoner of war camp, and, in the closing days of the war, as a medical rehabilitation center. When the last GI left, the Camp was again closed down and its military history came to an end.

Brookhaven Lab Started

On March 22, 1947, the government, through the Atomic Energy Commission turned over the site to the Associated Universities, Inc., an association of nine universities, and Brookhaven National Laboratory was born. The word Brookhaven described its location and the word National defined its scope.

Not only the site changed from war to peace, but many of the scientists who had worked on the Manhattan Project during World War II, turned to the development of the atom for peaceful uses. Through the Associated Universities, Inc., they were able to continue research on atomic energy which would have required facilities and talents too great for any single university to undertake.

As a former military site, Brookhaven started with complete utility and road system, a gymnasium, a swimming pool, tennis courts, office buildings and apartments and dormitories. Since that time much more has been added and many of the old barracks have been replaced by modern buildings and laboratories.

Reactor First Project

One of the first projects was to design and build a nuclear reactor that would be devoted exclusively to research. It was called the Brookhaven Graphite Research Reactor and it began operating in 1952, the first reactor of its kind.

The Graphite Reactor was followed by a series of accelerators – the Van de Graaff, the Cyclotron, the Cosmotron, and ultimately the Alternating Gradient Synchrotron, which at 33 BeV (billion electron volts) of energy, was the world's largest for many years. The Graphite Research Reactor and the Cosmotron have now been retired, but the AGS is still the largest accelerator in full-time experimental operation in the western world. Today, Brookhaven is one of the world's foremost centers for physics research.

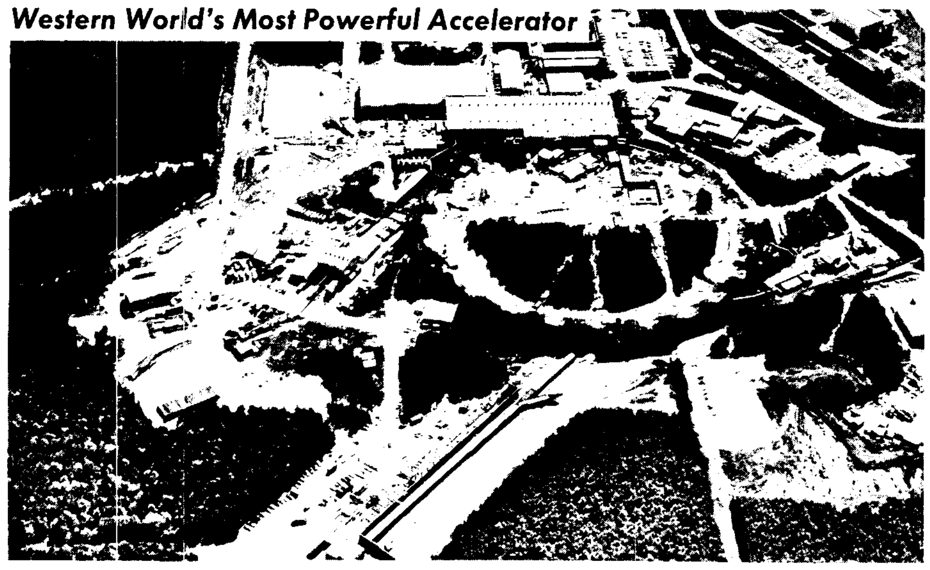
Other Facilities Added

Over the years, BNL has added a Medical Research Reactor, a High Flux Beam Reactor and a High Intensity Radiation Development Laboratory as part of the development of a broad complex of research facilities and programs, not only in physics but in the life sciences and chemistry as well. The successful operation of these many programs requires equally complex and sophisticated instrumentation, health physics, engineering, mathematics and other complementary activities.

And now, a 12-gram rock is giving heavy competition to the complicated machinery on site. This rock is part of a larger rock that weighed 919 grams when it was brought back to earth from the moon by the Apollo 11 astronauts. It will be analyzed by staff members of the Chemistry Department and their research will add to what is known about the moon's history and, hence, to man's knowledge about outer space and our universe.

The design, development, operation and maintenance of the sophisticated research facilities requires special talents and skilled personnel. Besides the Laboratory's highly trained regular staff, scientists from U.S. institutions and abroad spend varying periods of time at Brookhaven collaborating on research and using the facilities for which we were created.

Western World's Most Powerful Accelerator



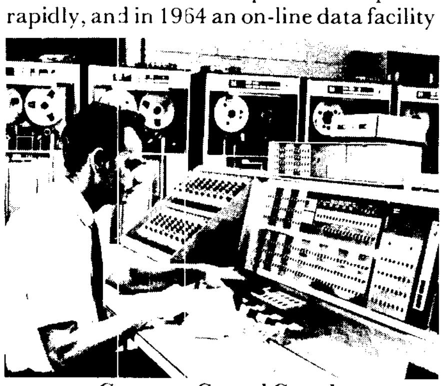
Air view of the 33-Billion electron volt Alternating Gradient Synchrotron. The circular form of the accelerator may plainly be seen in the center of the photo. To the left of the accelerator ring is the complex of buildings housing the 80-inch bubble chamber. The diagonal line at the bottom center of the picture is the new linear accelerator being installed at the synchrotron as part of a major modification program that will increase by five times the intensity of the beam of protons at each pulse of the accelerator.

Protons Jogged by 33-Billion Electron Volts Reach 99.9% Speed Of Light In Synchrotron

Computer Facility

Computers have revolutionized the conduct of scientific investigations and have become an indispensable tool in many fields of research. At Brookhaven, a large computer facility is centrally located to serve all the Laboratory's research programs, and smaller computers are used at experimental sites for specific applications.

In October 1962 the first on-line computer physics experiments were performed by Brookhaven scientists at the AGS. This series of experiments, which lasted a few months, would have required more than 10 years to complete by previous techniques. The use of on-line computers has spread rapidly, and in 1964 an on-line data facility



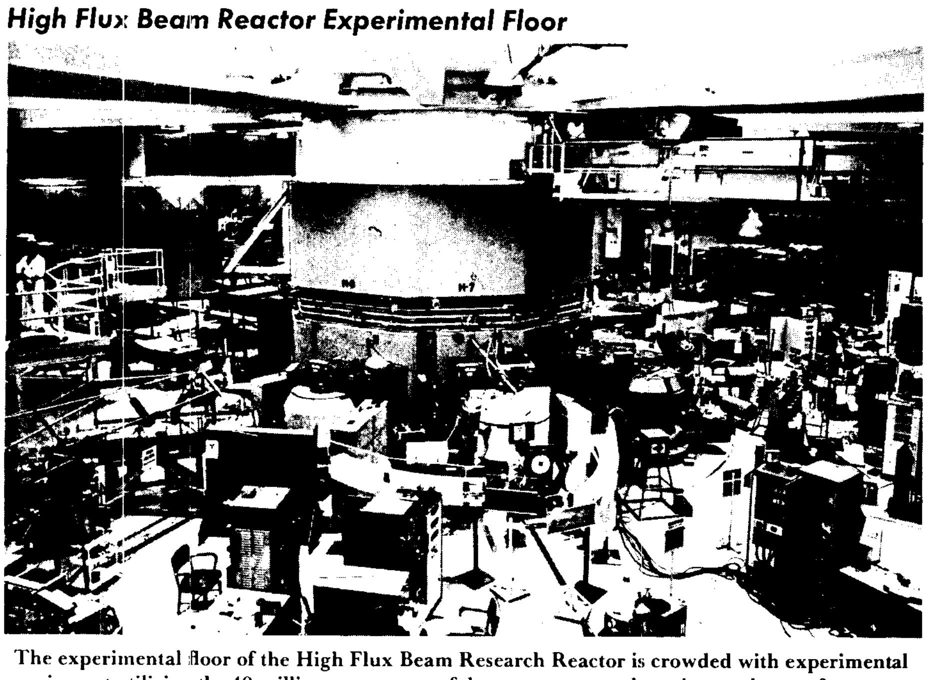
Computer Control Console

for physics research was established at Brookhaven. Early in 1965 a compact computer permanently mounted in a 40-foot trailer was added to this facility. This computer, intended primarily for particle research, is designed to be used simultaneously by several operators and accepts input from as many as 128 detection devices. It can be moved to various locations as required.

At the High Flux Beam Research Reactor a group of eight neutron spectrometers will be under the control of a single stored-program digital computer. The computer will control the operation of all the neutron detectors and monitors and, in addition, will handle the computation of the experimental data for all spectrometers.

The Alternating Gradient Synchrotron (AGS) was designed and built by Brookhaven scientists to explore the relatively unknown regions of high energy physics. The AGS is now the world's second largest accelerator; it was the largest from 1960 to 1968. This proton synchrotron operates at energies up to 33 BeV. The protons (from hydrogen atoms) are started on their journey to high energies by the Cockcroft-Walton generator, which provides an initial energy of 750,000 electron volts to the protons. They are then injected into a 110-foot-long, 50-million-electron-volt (MeV) linear accelerator, one of the largest proton linear accelerators in the world, which in turn injects the protons into the circular path of the AGS. In the main accelerating section of the synchrotron, contained in an underground tunnel 18 by 18 feet in cross section and one-half mile in circumference, the particles are accelerated in a vacuum chamber that is positioned in the jaws of 240 strong-focusing magnets. These magnets serve to keep the protons in their proper orbits. Acceleration is accomplished by means of radiofrequency accelerating stations spaced around the vacuum chamber. Within one second the protons travel more than 300,000 times around the machine, reaching a speed more than 99.9% of the speed of light (about 186,000 miles per second) with an energy greater than 30 BeV. At this time a target is inserted into the proton beam inside the vacuum chamber, or the proton beam is extracted magnetically and conveyed to a target outside the accelerator tunnel. When the protons strike the nuclei of the target atoms, various high energy particles are produced. Beams of these particles are conducted into the experimental areas, where they are detected in bubble chambers, spark chambers, scintillation counters, or photographic emulsions. The results serve to increase knowledge of the complicated nature of elementary particles and sometimes produce previously unknown or unobserved particles such as the omega-minus hyperon, first observed at the AGS.

High Flux Beam Reactor Experimental Floor



The experimental floor of the High Flux Beam Research Reactor is crowded with experimental equipment utilizing the 40-million watt power of the reactor to supply an intense beam of neutrons for nuclear research. The floor above the one pictured is used for control and fuel loading, and the floor below houses operating machinery and spent fuel storage facilities.

Form And Property Of Matter Studied At Brookhaven Lab

This area includes fundamental studies of atoms, atomic nuclei, and subnuclear particles and of conglomeration of atoms and molecules, i.e., solids, liquids, and gases. This research is basic to all science and involves a wide variety of equipment and experimental techniques.

In the field of particle physics, atomic structure and forces are studied by bombarding nuclei with ultra-high-energy particles from accelerators such as the 33-billion-electron-volt Alternating Gradient Synchrotron (AGS). When such accelerated particles collide and interact with nuclei, part of their energy is transformed into new particles which fly off from the target nuclei. These particles are then detected or their paths are made visible by devices such as scintillation counters, Cerenkov counters, bubble chambers, spark chambers, and photographs. By such means many new particles including mesons and hyperons have been discovered at the AGS and subsequently studied. Particle accelerators are used at many different energy levels in this research, since the type and number of nuclear events obtained vary with the energy and type of the bombarding particles.

The ultra-high-energy particles produced by the Alternating Gradient Synchrotron are also used by chemists in studies of high energy nuclear reactions.

The methods used consist of radiochemical determinations of the yields of products under various conditions; measurement of the angular and energy distributions of reaction products recoiling out of extremely thin metal targets; and observation of charged particles such as recoil nuclei, fission fragments, alpha particles, protons,

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and mesons in nuclear emulsions and in bubble chambers.

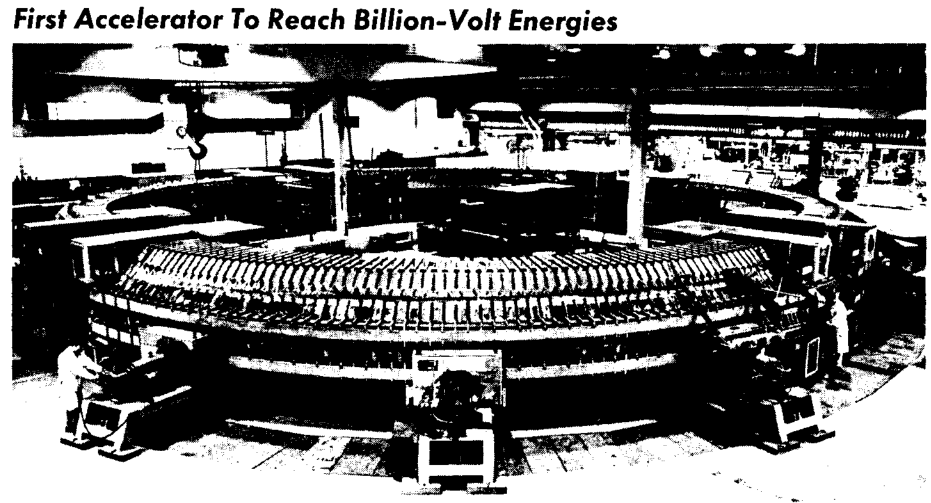
Low energy physics and low energy nuclear chemistry include investigation of various properties of nuclei. These studies require low energy particles from facilities such as the High Flux Beam Research Reactor, the Van de Graaff accelerators, and the 60-inch Cyclotron.

In solid state physics and structural chemistry studies, molecular and crystal structures are determined by the complementary techniques of x-ray and neutron diffraction. Neutron diffraction also reveals the atomic arrangements which determine the microscopic properties of magnetic materials.

The field of physical chemistry covers a wide range of experimental and theoretical studies subjects such as electron exchange reactions, reactivities of organic systems, ion-molecule reactions, and molecular excitation by electron impact.

Isotope chemistry investigations are concerned with the differences in the physical and chemical properties of isotopes and the uses of these differences in pure and applied science. These studies, which deal mostly with stable (nonradioactive) isotopes, are relevant to the understanding of the fundamental properties of molecules and to the separation of isotopes by chemical methods.

First Accelerator To Reach Billion-Volt Energies

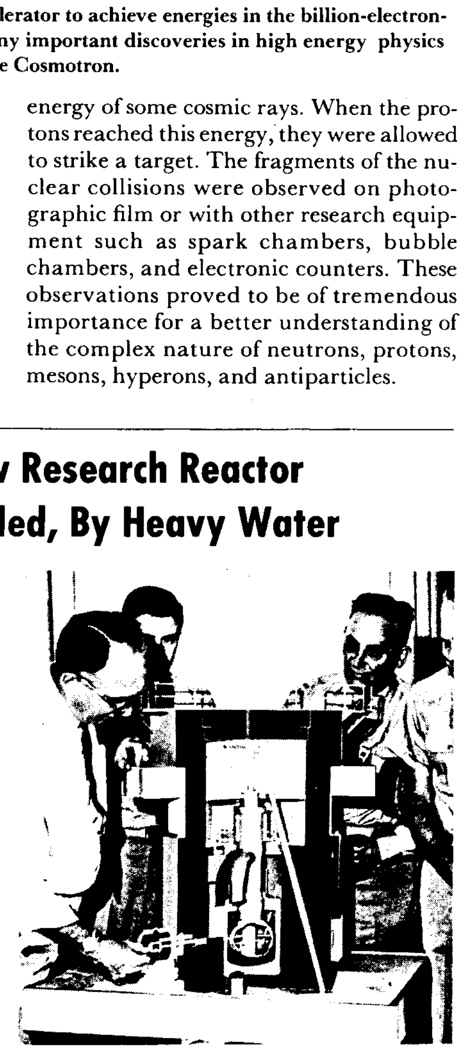


The Cosmotron was the world's first particle accelerator to achieve energies in the billion-electron-volt range. During the years of its operation, many important discoveries in high energy physics were made through experiments performed on the Cosmotron.

The Cosmotron was the first accelerator in the world to produce particles at BeV energies. It was a proton synchrotron, completed in 1952 and shut down on December 31, 1966. A doughnut-shaped electromagnet 75 feet in diameter guided the protons, injected by an electrostatic accelerator (now used for medical research), in a circular path. After one second of acceleration in the Cosmotron the protons had traveled 135,000 miles and reached an energy of 3 BeV, comparable with the energy of some cosmic rays. When the protons reached this energy, they were allowed to strike a target. The fragments of the nuclear collisions were observed on photographic film or with other research equipment such as spark chambers, bubble chambers, and electronic counters. These observations proved to be of tremendous importance for a better understanding of the complex nature of neutrons, protons, mesons, hyperons, and antiparticles.

Intense Beam Of New Research Reactor Is Moderated, Cooled, By Heavy Water

The High Flux Beam Research Reactor (HFBR) is one of the newest and most advanced design research reactors in the United States. It provides intense beams of neutrons for a variety of research purposes. As experimental techniques have improved, an increasing need has arisen for higher neutron fluxes. The essential feature of the HFBR is its compact core of enriched uranium fuel elements operating at high power density in heavy water. The heavy water surrounding the core serves as coolant, moderator, and reflector. The maximum total flux is about 1.6×10^{15} neutrons per square centimeter per second. The HFBR is housed in a three-story airtight, domed building. The bottom floor houses the operating machinery and the spent-fuel storage canal, the second or ground floor is for beam experiments and laboratories, and the top floor accommodates the control room, irradiation experiments, and fuel handling operations.



A model of the core of the HFBR is explained to visitors. This reactor is loaded from the top with enriched uranium fuel elements, that are removed from the bottom of the reactor when they are spent.

Electron Microscope

A metal sample is prepared for insertion into an electron microscope for metallographic examination. The special facilities of the Metallurgy Laboratory are used for the study of reactor materials at high temperatures, for the development of new reactor materials with special properties, and for the development of superior research equipment used in high energy experiments.

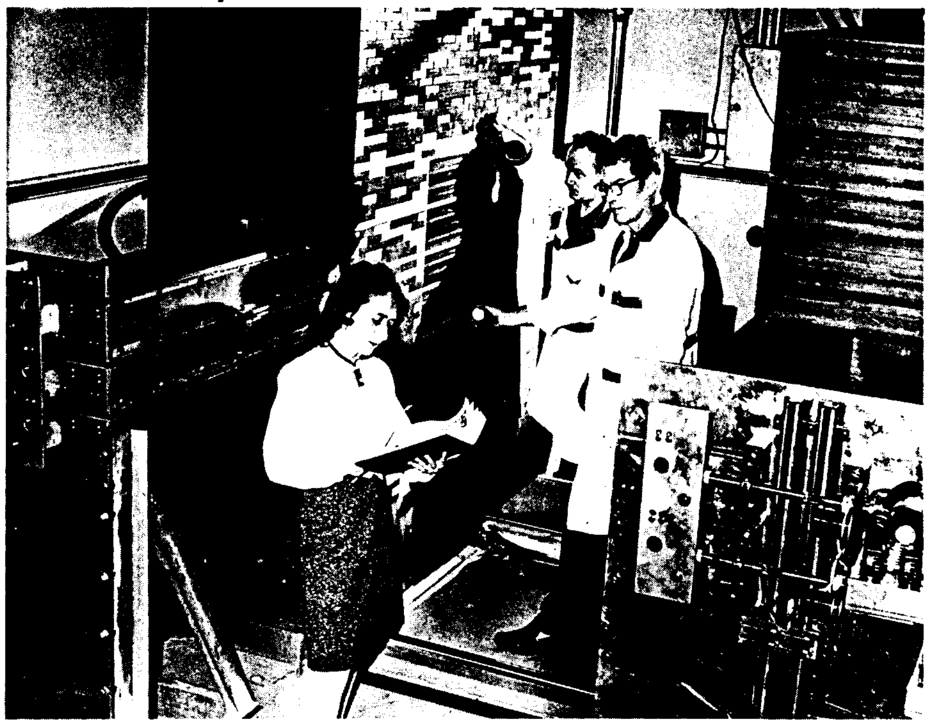
Research and Development In Nuclear Technology

This area covers research and development, not necessarily itself of a nuclear nature, directed toward solving the specific problems of nuclear energy utilization. Solutions are available to private industry for commercial development. The work in this area is of three main types.

The first, the largest in terms of effort, encompasses fundamental studies in such fields as reactor physics (both theoretical and experimental), the neutron scattering and absorbing properties of substances used in nuclear reactors, the metallurgy of reactor materials, the chemistry of elements of special interest in atomic energy such as uranium and plutonium, and liquid-metal heat transfer and containment.

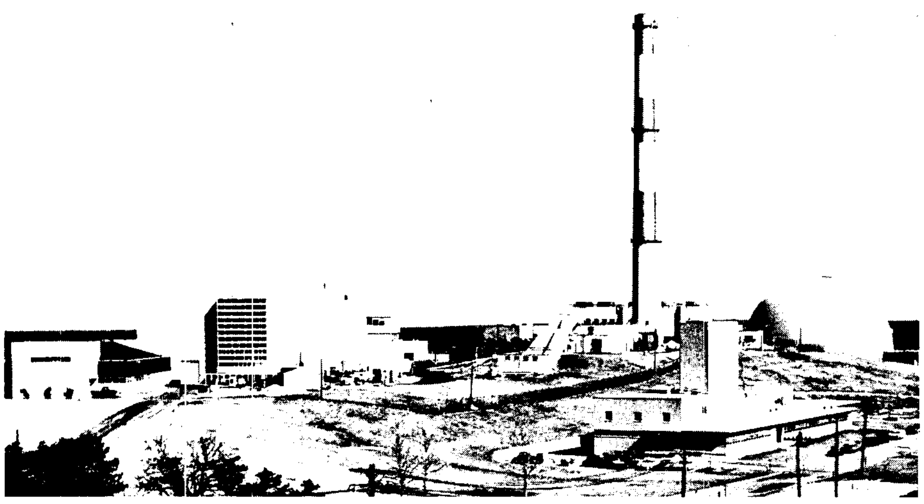
The second type of work consists of long-range development of components and entire systems that may bring about significant advances in reactor technology and radiation applications. Some of the more important phases are the development of new reactor fuels, improved fuel processing, radioactive waste disposal, and radiation engineering methods. In this last field a special facility, the High Intensity Radiation Development Laboratory (HIRDL), is being used for engineering studies with radiation sources in the million-curie range.

Critical Assembly Checked Out



The Critical Assembly Laboratory contains some very specialized facilities for research in reactor physics and reactor development. The experimental area has five zones, each containing an assembly cell and its associated control area. Two of these zones are used for critical assemblies (chain-reacting arrangements of nuclear fuel), two contain neutron source reactors, and the last has a 1-MeV pulsed neutron source (Van de Graaff accelerator). An additional critical assembly is located in an adjacent steel silo building.

Two Reactors Share Stack



Both the Brookhaven Graphite Research Reactor (left) and the High Flux Beam Reactor (dome to right) share the tall stack for venting exhaust air.

Radiation Lab Uses Cobalt-60 In Research

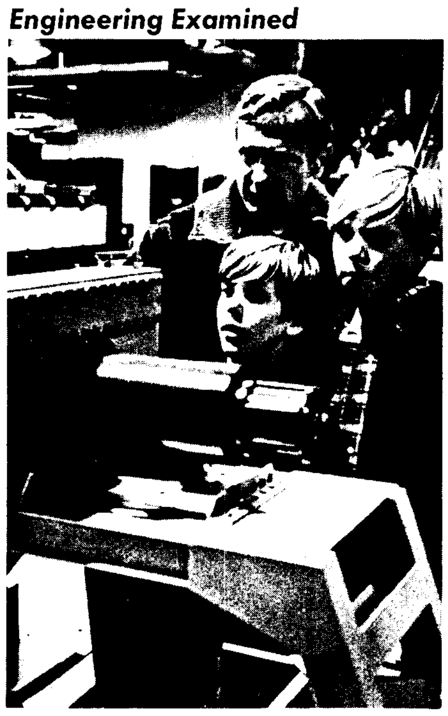
The High Intensity Radiation Development Laboratory (HIRDL) has been designated by the Atomic Energy Commission to serve as a focal point for radiation research and development in the United States. In this laboratory cobalt-60 and cesium-137 are used in obtaining data on a variety of radiation sources in the million-curie range and in developing more efficient techniques for handling large-scale radiation sources. The facility is also widely used in research on irradiation of food for extension of shelf-life (pasteurization dose) or for indefinte storage without refrigeration (sterilization dose).

The research and development program at HIRDL covers such subjects as high-level dosimetry with solid state, glass, and chemical dosimeters; the effects of intense radiation fluxes on both homogeneous and heterogeneous samples; self-absorption of gamma rays in large sources or source arrays; and the design, standardized production, handling, transportation, and use of large gamma sources. This information is used at Brookhaven to design special irradiation facilities, two examples of which are a shipboard irradiator to pasteurize fish as it is caught and a bulk grain irradiator to destroy insects in grain prior to its storage or shipment.

Mechanical Hands

Visitors at HIRDL are fascinated as they watch mechanical hands write initials on souvenir booklets.

Engineering Examined



The fascination of precise engineering is evidenced by this family group examining a magnet section for the Alternating Gradient Synchrotron.

New Instrumentation Designed At Brookhaven

Instrumentation above and beyond the general standard is a necessity for modern research. Many research programs at Brookhaven require the design and development of instruments not commercially available. Examples are seimconductor detectors to permit more precise energy measurements of heavy charged particles; multichannel analyzers to determine the energies of the gamma rays or particles from radioactive materials; systems of fast circuits to make measurements in billionths of a second and to count up to 100 million pulses per second to handle the fast counting rates in detectors at the accelerators; and data systems to detect nuclear interactions, store the information in a memory system, and at the same time transmit previously obtained data to a computer for analysis.

Brookhaven Research Varied

Brookhaven's research covers a wide variety of specific areas in the physical, life, and related sciences in which the development and exploitation of nuclear science and technology are involved.

Research interests sometime overlap from one scientific field to another, and similar problems are often approached from several points of view. Moreover, nuclear research is frequently supported or complemented by nonnuclear research.

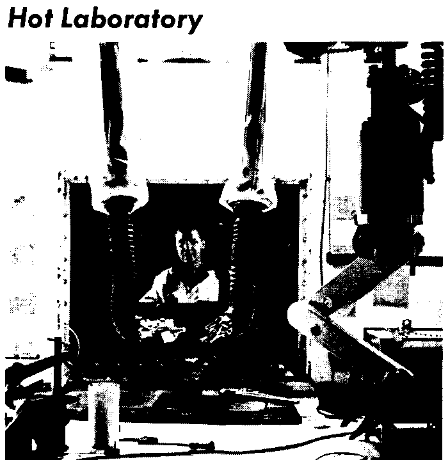
Scientific Answer Man

The Scientific Answer Men at Brookhaven are prepared to answer all questions of a serious nature about work at the laboratory.

Nuclear Reactors

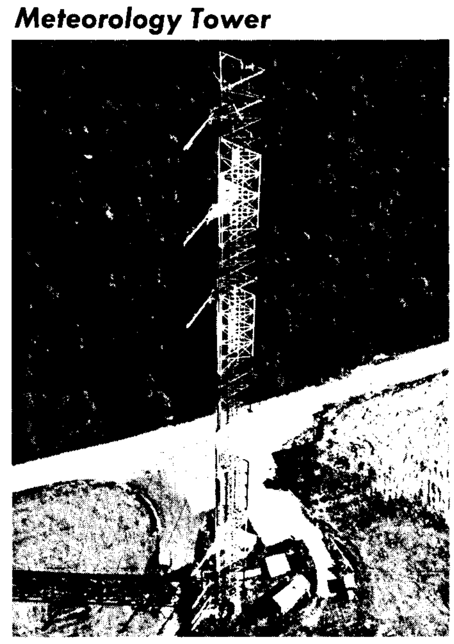
The reactors at Brookhaven play a very important role in the research program. These machines provide beams of neutrons for various types of experiments. Neutrons, as a fundamental part of the atom, are studied in themselves and are among the most powerful tools available to experimenters in such fields as nuclear and solid state physics, metallurgy, and nuclear and structural chemistry. The Brookhaven reactors are also used to produce radioactive isotopes for research.

Hot Laboratory



The Hot Laboratory is designed for experimentation with highly radioactive material in "hot cells," where radioactve materials may be safely handled by "master-slave" manipulators and other special remotely operated devices. An important part of the work at the Hot Laboratory has been processing and packaging of radioactive isotopes to be used at laboratories and hospitals all over the world.

Meteorology Tower



The 420-foot-high Ace tower

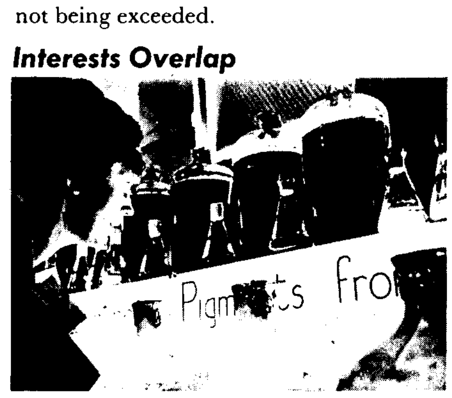
Air Pollution Studied Closely

Meteorology and Climatology are an integral part of the research at Brookhaven for the general benfit of nuclear science and air pollution studies. The distribution of airborne particles and gases is studied by the use of tracer materials such as variously colored smokes and fogs, which show the movements of air and the rate at which materials in it are dispersed or deposited on the ground. The effect of forests and other heavy vegetation on the dispersion of materials in the atmosphere is also a major interest. Two towers, 160 and 420 feet high, have instruments to record weather data and can be used to release smoke or fog trails at various heights.

Health Physics Checks Hazards

Health Physics personnel are responsible for insuring that no one, on or off the site, is exposed to harmful amounts of radiation originating at the Laboratory. Many types of fixed and portable instruments are used to measure the radiation levels in work areas to insure that no hazards exist, and bio-assays and individual dosimeters such as film badges are employed to make certain that no one at the Laboratory is receiving harmful amounts of radiation. Radiation levels are continuously measured to insure that allowable limits are not being exceeded.

Interests Overlap



Overlapping interests in nuclear research bring biological specimens under the scrutiny of physicists.

Concrete Polymer

The concrete-polymer was developed at the Brookhaven National Laboratory by saturating ordinary concrete with a liquid monomer plastic and then irradiating it with gamma rays to solidify the plastic into a polymer. The result is a new concrete-polymer that is four times stronger than ordinary concrete, is virtually water-proof, and highly resistant to many sources of corrosion. Concrete-polymer can be produced in a variety of shapes and sizes for building and many other uses. When polished, it takes on the appearance of marble. The new product was developed in a joint program with the Department of the Interior's Bureau of Reclamation and Office of Saline Water.

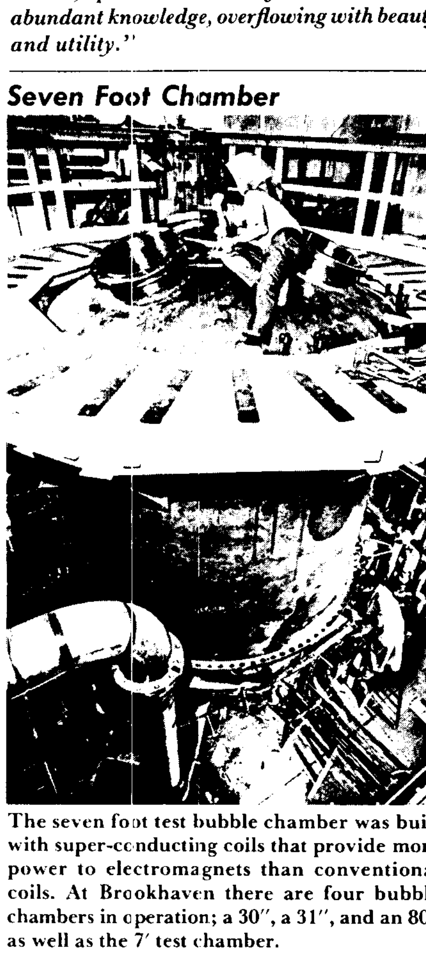
Lab Operated For AEC By University Group

Brookhaven National Laboratory, as an integral part of our nation's atomic energy research facilities, is a national center for fundamental and applied research in the nuclear and related sciences.

The Laboratory is operated by Associated Universities, Inc., a nonprofit national research management corporation, under contract to the United States Atomic Energy Commission. There are nine sponsoring universities: Columbia, Cornell, Harvard, Johns Hopkins, Massachusetts Institute of Technology, Princeton, University of Pennsylvania, University of Rochester, and Yale.

While it has been possible to present in this paper a brief outline of the current major research activities of the Laboratory, it is impossible to do more than suggest some of the new fields of endeavor that will open up in the years ahead. The lines of approach to problems are constantly shifting as new discoveries are made in all the rapidly developing areas of nuclear science and technology. The words of the brilliant English scientist Michael Faraday, spoken 100 years ago, are still most appropriate today:
"It is the great beauty of our science that advancement in it, whether in a degree great or small, instead of exhausting the subject of research, opens the doors to further and more abundant knowledge, overflowing with beauty and utility."

Seven Foot Chamber



The seven foot test bubble chamber was built with super-conducting coils that provide more power to electromagnets than conventional coils. At Brookhaven there are four bubble chambers in operation; a 30", a 31", and an 80" as well as the 7' test chamber.

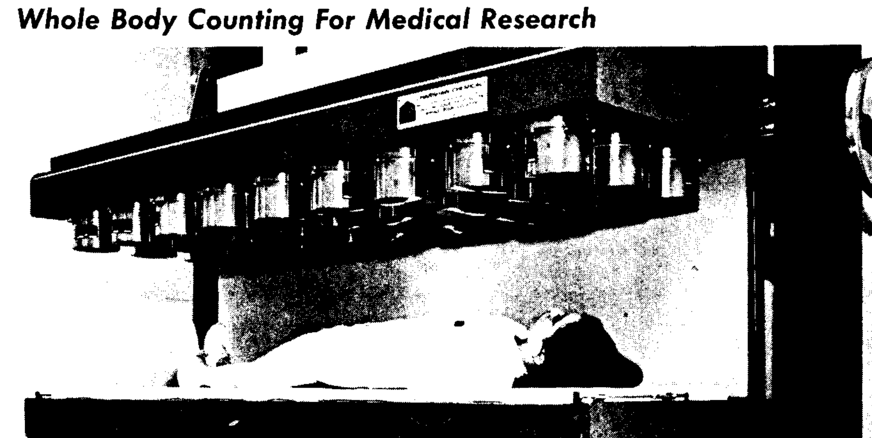
Radioisotopes And Other Nuclear Tools Used In Research

This very broad and diversified area involves the use of electromagnetic radiation, neutrons, charged particles, and radioactive isotopes in all branches of scientific research and development. Radiation and particles are used as probes to study physical and chemical structures by observing their penetration and reflection or to effect changes of an informative nature. Similarly, radioactive isotopes, employed as "tracers" because they can be readily located, have become a very useful and versatile tool.

In the field of chemistry, radioactive isotopes are being used as tracers either to study the way in which chemical reactions take place and the rates at which they occur, or to label complex compounds to determine how they are involved in the chemical or biochemical synthesis of other complex compounds.

The biology research program is concerned with the interaction of radiation and radioactive isotopes with living matter and the use of these tools in studying fundamental biological processes. The use of mathematical methods is rapidly making biology an exact science in which biological function is studied at the atomic and molecular level. The chromosomes, which determine the function of the cell, are composed of special molecules so constructed that they can be assembled in an almost infinite number of ways. Protein molecules are extremely complex and can therefore perform extremely exacting tasks in the cell. The way in which sunlight is transformed into food by a plant (photosynthesis) is one of the most complex and important chemical reactions known. These are some of the problems in biology attacked at the molecular level, mainly through the use of radioactive isotopes. Radioisotopes are excellent tracers for studying the structure of extremely complex organic molecules and the reactions in which they take part.

Whole Body Counting For Medical Research



Whole-body counting is accomplished in the Medical Research Center by this 54-crystal low level counter. One array of 27 crystals is above the patient and another similar array is below. The counter is housed in a shielded room to reduce background radiation levels as much as possible.

Linear Accelerator

A completely shielded room has been constructed to house the Cockcroft-Walton injector for the new Linac of the Alternating Gradient Synchrotron. In this shielded room the particles will originate that eventually reach a speed of 99.9% the speed of light before striking a target.

Medical Research Center

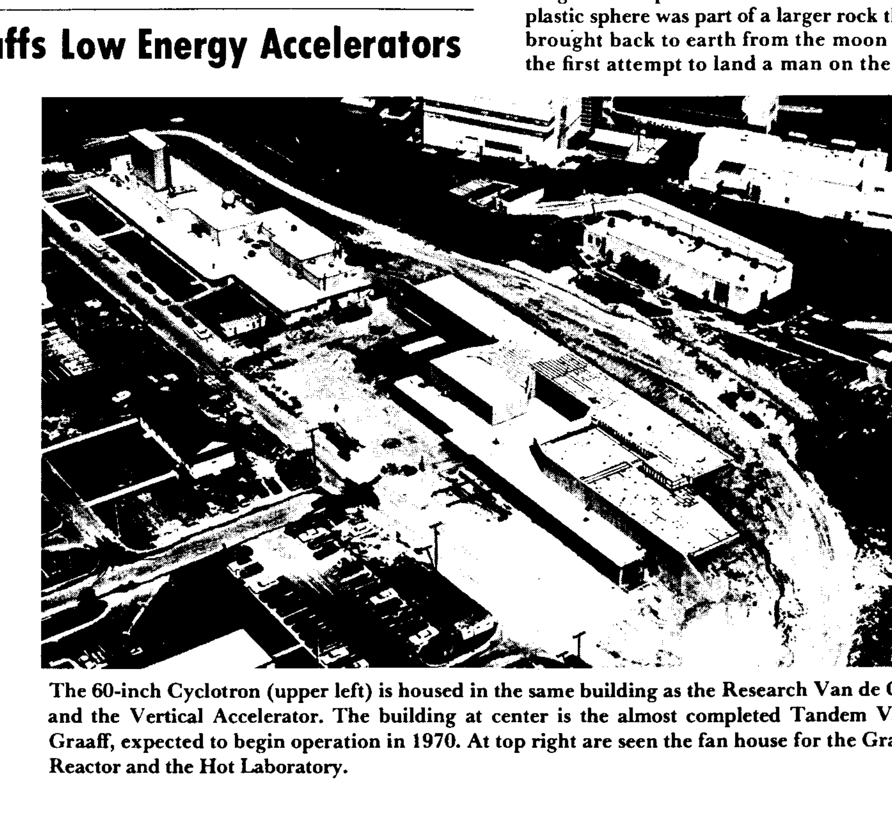
Although all the special facilities of the Laboratory are available to the scientists working in the field of nuclear medicine, most of their research activities are carried on in the Medical Research Center. The Center includes laboratories, offices, special service facilities, a medical library, an industrial medicine clinic, and a 48-bed research hospital to accommodate patients referred to Brookhaven by physicians in connection with special observations and therapy under development. A unique feature of the Center is the Medical Research Reactor, constructed for the purpose of exploring the possible applications of nuclear reactors in the study of man and the diseases of man. Other special features of the Center include whole-body counters, which are shielded to minimize interference from background radiation.

The Medical Research Reactor (MRR) is an integral part of the Medical Research Center, connected by air-lock doors to laboratories for medical physics, pathology, microbiology, biochemistry, and physiology. The core of enriched uranium fuel elements is cooled and moderated by natural water, and the graphite reflector is cooled by forced air. Two ports, one on each side of the reactor, permit streams of neutrons from the core to pass through the heavy concrete shielding walls to research rooms.

Cyclotron And Van de Graaffs Low Energy Accelerators

The Tandem Van de Graaff, currently under construction, is expected to begin operation in 1970. It will consist of two Van de Graaff accelerators arranged to allow operation of each independently, with energies up to 20 MeV, or of both in series, as a 30-MeV accelerator. This arrangement will make it possible to perform a wide variety of experiments on nuclear structure at energies ranging from a few MeV to 30 MeV for singly charged particles.

The 60-inch Cyclotron accelerates particles by repeatedly passing them through an electric field as they spiral outward in the field between the poles of a large electromagnet (the pole diameter is 60 inches). Modifications to the magnet pole tips and the radiofrequency oscillator have been made to allow the acceleration of deuterons (heavy hydrogen nuclei) to 20 MeV, protons and alpha particles (helium nuclei) to 40 MeV, and helium-3 ions to 60 MeV. These accelerated particles are used for nuclear reaction studies, the production of radioactive materials, and irradiation of biological systems.



The 60-inch Cyclotron (upper left) is housed in the same building as the Research Van de Graaff and the Vertical Accelerator. The building at center is the almost completed Tandem Van de Graaff, expected to begin operation in 1970. At top right are seen the fan house for the Graphite Reactor and the Hot Laboratory.

Ecology Forest

A BNL ecologist looks at the holder for a 9,500-curie source of cesium-137 that is slowly killing vegetation in the 50-acre forest. This long term study is designed for investigating the effects of chronic exposure to ionizing radiation.

Physical, Chemical, And Biological Effects Of Radiation Are Studied

Studies in this area are of interest in clarifying the effects themselves and as a means of gaining information about the fundamental properties of the substances or organisms involved.

The problems of biology and medicine are increasingly being studied and understood in terms of the structures and functions of the molecules that make up the living cell.

In the medical research program the broad effort to improve understanding of the biological processes in man includes studies to improve diagnosis and therapy and to define more clearly the character of certain diseases, as well as basic investigations at the subcellular, biochemical, and molecular levels. These efforts are increasing knowledge of both the uses and effects of radiation in humans.

Lunar Sample Display

A Brookhaven Laboratory Security Officer stands guard at the moon sample display. The 12-gram sample mounted in the middle of a plastic sphere was part of a larger rock that was brought back to earth from the moon during the first attempt to land a man on the moon.